

# Gas-Particle Interactions Working Group Summary

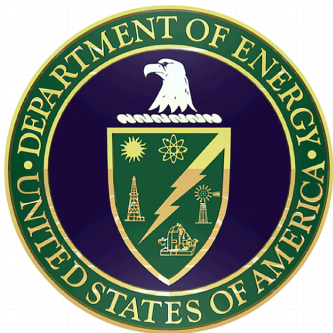
Rahul Zaveri

Pacific Northwest National Laboratory

ASP Science Team Meeting

Annapolis, MD

February 26, 2008



# Members

- |     |                   |                                       |
|-----|-------------------|---------------------------------------|
| 1.  | Liz Alexander     | Pacific Northwest National Laboratory |
| 2.  | Simon Clegg       | University of East Anglia, UK         |
| 3.  | Mary Gilles       | Lawrence Berkeley Laboratory          |
| 4.  | Lawrence Kleinman | Brookhaven National Laboratory        |
| 5.  | Rao Kotamarthi    | Argonne National Laboratory           |
| 6.  | Alex Laskin       | Pacific Northwest National Laboratory |
| 7.  | Yin-Nan Lee       | Brookhaven National Laboratory        |
| 8.  | Sasha Madronich   | NCAR                                  |
| 9.  | Ryan Moffet       | Lawrence Berkeley Laboratory          |
| 10. | Douglas Worsnop   | Aerodyne Research, Inc.               |
| 11. | Anthony Wexler    | University of California, Davis       |
| 12. | Yong Yu           | University of California, Irvine      |
| 13. | Rahul Zaveri      | Pacific Northwest National Laboratory |

# Our Purview...

Process-oriented field measurements and modeling of aerosol size, composition, and mixing-state evolution, with a focus on

**carbonaceous aerosols  
and their precursors**

# Major Uncertainties in Aerosol Processes...

- Particle size distribution, composition, density, hygroscopicity, and optical properties of different types of primary and secondary carbonaceous aerosols
  - Gasoline, diesel, cooking, biomass burning POA
  - Anthropogenic, biogenic, and marine SOA
- Evolution of aerosol mixing state via coagulation and condensation, and their effects on optical properties
- Gas-particle partitioning of organic species
  - Inorganic-organic thermodynamics
- Heterogeneous chemistry
  - SOA formation
  - Nighttime  $\text{N}_2\text{O}_5$  and  $\text{NO}_3$

# Partial Summary of Current Status...

## Gas and Aerosol Instruments

- Particle size and composition measurement capabilities
  - AMS (size-resolved and single particle)
  - SPLAT (single particle)
  - SP2 (size-resolved and single particle)
  - Microprobe and microscopy techniques (single particle)
  - FIMS (aerosol size distribution @ 1 s)
- Gas-phase organics measurement capabilities
  - PTRMS
  - Canister
  - **Currently missing SVOC measurement capability within ASP**

# Partial Summary of Current Status...

## **Aerosol Box Models**

- Online aerosol thermodynamics model AIM2
- NCAR Master Chemical Mechanism (MCM)
- Model for Simulating Aerosol Chemistry and Interactions (MOSAIC) – also implemented in 3-D WRF-chem
- Particle-resolved version of MOSAIC, coupled with shell-core optics module

# Path Forward...

## Process Model Development

- Contribute to the design, development, and evaluation of various ASP-supported aerosol process modules:
  - Inorganic-organic thermodynamics module (Extended-AIM2)
  - Offline SOA module based on MCM + Extended AIM2
  - MOSAIC with SOA (based on MCM + Extended-AIM2)
  - MOSAIC with other available SOA modules (e.g., Rob Griffin's SOA)
- Collaborate with **Organic Aerosol Formation WG** in the use of laboratory measurements to develop and evaluate thermodynamics and SOA formation modules
- Collaborate with the **Optical Properties WG** in the use of laboratory and field measurements of absorption and scattering to conduct local closure experiments

# Path Forward...

## **Process-Oriented Field Measurements**

- Contribute to the design and execution of the anticipated clear-air ASP field campaign focused on carbonaceous aerosol evolution
- Consult/involve Tami Bond to develop a size- and composition-resolved emissions inventory
- Develop a coherent aircraft and ground sampling strategy suitable for directly observing time evolution of primary and secondary aerosols
- In addition to the standard 3-D model evaluation of field measurements, conduct detailed box-model analysis of high-resolution gas and particle measurements to gain new and unique insights into aerosol formation and evolution.



# Evaluation of Process Modules in 3-D Models...

- Collaborate with the **Modeling WG** to implement reduced and computationally-efficient versions of detailed aerosol chemistry process modules in 3-D regional and global models. Collaborate with 3-D modelers in the evaluation and interpretation of clear-air field measurements using the new aerosol process modules
- Collaborate with **Cloud-Aerosol Interactions WG** to implement new aerosol chemistry modules in CCN activation codes and couple them with cloud-chemistry modules. Collaborate with cloud modelers in the evaluation and interpretation of field measurements using the new aerosol process modules.

# Products and Deliverables...

- GPI WG website describing our plans, progress, accomplishments, peer-reviewed publications, and links to various aerosol modules and data products
- Self-documented, publicly accessible detailed aerosol chemistry modules
- Computationally efficient aerosol chemistry modules suitable for use in 3-D regional and global models
- Intercomparison of similar aerosol modules in a box-model framework, with benchmarking where possible
- Peer-reviewed publications